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여름 豆類 및 禾本科飼料作物의 青刈收量 및 飼料價値

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Forage Yield and Quality of Summer Grain Legumes and Forage Grasses

by

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DEPARTMENT OF AGRICULTURE
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Forage Yield and Quality of Summer Grain Legumes and Forage Grasses

Min-Su Kang

(Supervised by Professor Young-Kil Kang)

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CONTENTS

ABSTRACT

Soybean [*Glycine max* (L.) Merr.], mungbean [*Vigna radiata* (L.) Wilcz.], cowpea [*V. unguiculata* (L.) Walp.], adzuki bean [*V. angularis* (Willd.) Ohwi & Ohashi], maize [*Zea mays* L.], sorghum [*Sorghum bicolor* (L.) Moench], sorghum × sudangrass [*S. bicolor* intraspecific hybrid], and Japanese millet [*Echinochloa crusgalli* var. *frumentacea* (Link) W.F. Wight] were grown at two planting dates (18 June and 15 July) at Cheju in 1997 to select the best forage legumes adapted to Cheju Island for grass-legume forage rotation. Averaged across planting dates and cultivars, dry matter (DM), crude protein (CP), and total digestible nutrient (TDN) yields were 5,646, 1,056 and 3,637 kg/ha for soybean, 4,458, 676 and 2,661 kg/ha for mungbean, 3,289, 553 and 2,055 kg/ha for cowpea, 3,931, 674 and 2,489 kg/ha for adzuki bean, 12,695, 969 and 7,642 kg/ha for maize, 17,071, 1,260 and 8,857 kg/ha for sorghum, 16,355, 1,163 and 8,543 kg/ha for sorghum × sudangrass hybrid, and 8,288, 929 and 4,091 kg/ha for Japanese millet. Soybean was higher in CP, ether extract (EE) and TDN contents but was lower in nitrogen free extract content compared with the three other legumes. The legumes had much higher CP (13.7 to 21.9%), EE (2.42 to 6.23%) and TDN (58.7 to 69.9%) contents but lower in crude fiber (CF) content (17.3 to 25.3%) than did the grasses tested except maize which had relatively lower CF

content but higher TDN content. These results suggest that soybean could be the best forage legume for grass-legume forage rotation in Cheju region.

.II IIIFKFKFKKF I . INTRODUCTION

Sorghums including sorghum × sudangrass and Italian ryegrass are recommended for summer and winter forage crops, respectively, in Cheju Island because of their high productivity. The recommended N rates for sorghums and Italian ryegrass are 250 and 200 kg/ha, respectively. Growing these grasses every year will increase NO_3-N contamination of ground waters and lead to a decrease in pH with an accompanying decrease in forage yields unless lime sufficient to neutralize the acidity formed is applied to the soil (Tisdale & Nelson, 1975).

It is very important to reduce the NO_3-N contamination of ground waters in this region because ground waters are the main sources of drinking water. Of 163 drinking-water wells in the island, 18 wells exceeded the Korean drinking-water standard (10 mg N/L) in 1993 and fertilizer N was considered to be an important source of NO_3-N to ground water. Present water pollution concerns make grass-legume rotation an attractive means to reduce use of N fertilizers. In addition to a decreased need for N fertilizer for subsequent crops, growing legumes in rotation increases yields and helps to control pests (Bagayoko et al., 1992; Porter et al., 1997). However, there is no popular summer annual forage legume in the island because high yielding summer annual forage legumes have not developed in Korea. Before N fertilizers were readily available and cheap, soybean was a popular main summer annual green manure and forage legume in Cheju province. Soybean appears a good forage legume for grass-legume rotation in Korea where cultural practices for perennial legumes have not well established (Lee et al., 1995; Shin, 1987). In the USA, perennial legumes have now largely replaced soybean for forage production but soybean is still considered a viable alternative forage during periods of decreased productivity of perennial forage species (Hintz et al., 1992; Munoz et al., 1983). There is little information on forage yield and quality of summer annual grain legumes in this region. The objective of this study was to determine forage yield and quality of summer annual grain legumes in order to select the best forage legumes adapted to this region for grass-legume forage rotation.

Ⅱ. LITERATURE REVIEW

Nitrogen fixation by legumes provides an opportunity for forage plants to obtain N from the earth's atmosphere rather than from commercial fertilizer (Miller and Heichel, 1995). This may have benefits to the farmer and environmental benefits to society. Total amount of nitrogen fixed by legume species or by legume-grass community varies widely. The amount of nitrogen fixed by legumes varied from 5 to 254 kg/ha/growing season.

Crop rotation plays an important role in the maintenance of soil fertility, improvement of soil physical properties, reduction of soil pathogens, and control of soil erosion (Bagayoko et al., 1992). Yield increase due to crop rotations ranges from 5 to 1 6% for soybean (Roder et al., 1989; Johnson, 1987) and 15 to 94% for grain sorghum(Peterson and Varver, 1989; Clegg, 1982; Gakale and Clegg, 1987). Bagayoko et al. (1992) found that plots with soybean as the previous crops for 8 years had 44 to 50 kg/ha more NO_3-N in the 150cm soil profile than did plots with continuous grain sorghum. Adams (1974) found that previous crop rotation influenced soil water intake and erosion for twenty months, and crop yields for one to four years. He also found that soil organic matter and soil water intake decreased after 5 years of continuous grain sorghum.

Although presently grown almost entirely as an oil-seed crop, soybean was previously a popular summer annual forage legume in Cheju Island and USA (Hintz et al., 1992). Soybean forage production currently represents less than 3% of the total soybean acreage in USA. Perennial legumes have now largely replaced soybean for forage production in USA; however, soybean is still considered a viable alternate forage during periods of decreased productivity of perennial forage species.

There is cultivar difference in soybean forage yields (Hintz et al., 1992; Lee et al., 1995). Lee et al. (1995) reported that Togukong produced the highest forage yield at 80 and 90 days after planting among 10 cultivars evaluated at Chungju in 1989 to 1991. According to Hintz et al. (1992), late maturing cultivars produced greater forage yields but lower quality forage when harvested at the same stage of development.

Munoz et al. (1983) evaluated that soybean forage yield at plant densities ranging from 97,000 to 291,300 plants and observed an increase in forage yields with increased plant densities. Hintz et al. (1992) found that increasing planting rate from 280,000 to 890,000 seeds/ha did not affect soybean forage yield.

Soybean hay yield increases with maturity. Shin(1987) reported that the dry matter yield of a soybean cultivar at Taegu, Korea in 1984 was 2,870, 7,000, 8,930, and 12,440 ㎏/ha at bloom, mid-formation of pod development, complete formation of pod development, and just before dough stage, respectively. Lee et al. (1995) found that dry matter yield of 10 cultivars averaged across 3 years ranged from 3,408 to 5,653, 4,679 to 7,048, 6,020 to 10,603 kg/ha at 70, 80 and 90 days after planting, respectively. Hintz et al. (1992) reported that in Wisconsin, USA, soybean forage yield increased from 2.4 Mg/ha when harvested at R1 to 7.4 Mg/ha when harvested at R7. Munoz et al. (1983) also found that the forage yield of soybean markedly increased with maturity and obtained a total dry matter yield of 12.4 Mg/ha when the pods were filled and leaves were beginning to turn yellow.

Shin (1987) reported that crude protein of soybean forage declined from 19.1 to 13.6 but crude fiber content increased from 23.8 to 30.1% as harvesting delayed from bloom to just before dough stages. Munoz et al. (1983) found that percentage of crude protein of soybean shoots was maximized at R6. According to Hintz et al. (1992), crude protein concentration of soybean forage declined from R1 (20.1%) to R3 (18.1%), remained constant between R3 to R5 (18.2%) but increased R5 to R7 (19.2%). They also reported that neutral detergent fiber, acid detergent fiber, acid detergent lignin concentrations increased from R1 to R3 and then decreased form R5 to R7.

According to Munoz et al. (1983), digestibility of soybean shoots slightly decreased with increased planting densities and was nearly constant from R1 to R7. The leaves and pods were much more digestible than the stems. Digestibility of stem decreased substantially beginning with pod development, but the increasing amount of highly digestible pods counteracted this effect of stems on shoot digestibility

Lee et al. (1996) evaluate the total dry matter, protein yield, palatability of 5 cowpea cultivars in 1989 to 1981 and found that the total dry matter and protein yields of the 5 cultivars averaged across 3 years ranged from 1,215 to 2,251 kg/ha and from 218 to 402 kg/ha, respectively. They also reported that viny cowpea varieties had higher yield than vertical ones and the palatability of cowpea forage was much lower than that of sudangrass hybrid and soybean forages.

Ⅲ. MATERIALS AND METHODS

This field study was conducted at the Research Farm of College of Agriculture, Cheju National University (33°N latitude, 277 m altitude) on volcanic ash soil at Cheju in 1997. The initial chemical properties of surface soil (0~10 cm) were shown in Table 1. Three soybean cultivars (Baegunkong, Namhaekong, and Sobaeknamulkong), two mungbean cultivars (Keumsungnogdu and Nampyungnogdu), one Cheju native cowpea, ′Chungjupat′ adzuki bean, ′Pioneer 3525′ maize, ′Pioneer 931′ sorghum, ′Pioneer 988′ sorghum × sudangrass hybrid, and one Cheju native Japanese millet were planted on 50-cm row spacing on 18 June and 15 July, respectively.

Table 1. The initial chemical properties of surface soil (0~10cm) at the experimental sites.

Planting date	pH (1:5)	O.M (g/kg)	Av. P_2O_5 (mg/kg)	Ex. cations($cmol^+/kg$)				CEC ($cmol^+/kg$)	EC (dS/m)
				Ca	Mg	K	Na		
18 June	5.5	53.9	149	3.10	1.34	1.32	0.27	10.3	0.14
15 July	5.3	47.4	219	2.16	1.07	1.34	0.22	8.53	0.13

At planting, legumes were fertilized with 40 kg N/ha, 70 kg P_2O_5/ha, and 60 kg K_2O/ha. Maize, sorghum, sorghum × sudangrass hybrid, and Japanese millet were fertilized with 100 kg N/ha, 150 kg P_2O_5/ha, and 100 kg K_2O/ha except Japanese millet which received 60 kg N/ha. At 46 days after planting (7 to 8 leaf stages), 100 kg N/ha was applied to maize planted on 18 June but not on 15 July because of dark green leaves of plants seeded on 15 July. Japanese millet planted on 18 June was fertilized with 45 kg N/ha after the first harvest. Nitrogen, P_2O_5 and K_2O were applied as urea, fused phosphate, and muriate of potash. Plant populations for soybean and mungbean were 400,000 plants/ha and those for adzuki bean and maize were 533,000 and 100,000 plants/ha, respectively. Seeding rate for sorghum, sorghum × sudangrass hybrid and Japanese millet was 30 kg/ha. The herbicide alachlor (2-chloro-2′, 6′-diethyl-N-〔methoxymethyl〕 acetanilide) granules at 2.0 kg a.i./ha were broadcast applied as pre-emergence for legumes and maize. Any herbicide was not applied for sorghum, sorghum × sudangrass hybrid, and Japanese millet, and all plots for these crops were hand-weeded.

Individual plots had five rows with 4 m long. The experimental design was a randomized complete block with four replications. Early season injury by bean stem miner (*Melanagromyza sojae* Zehntner) resulted in poor stand establishment of cowpea and adzuki bean planted on 18 June and data for the two crops planted on 18 June were not collected.

Temperature and rainfall data (Table 2.) were obtained from the Cheju Agricultural Experiment Station located about 4.1 km from the experiment site. The mean air temperatures for June and July were above normal and those for August through October were below normal. Rainfall for these six months was below normal. Rain and wind on 5 and 6 August resulted in the severe lodging of the grasses. Several days after lodging, 93% of maize, sorghum and sorghum × sudangrass hybrid plants and 79% of Japanese millet plants recovered from the lodging. The lodging might somewhat decrease the DM yield of the grasses.

Table 2. Normal mean air temperature and precipitation, and departures from normal from 1996 growing season at Cheju.

Month	Mean air temperature (℃)		Precipitation (㎜)	
	Normal†	Departure‡	Normal	Departure
June	20.8	+1.5	174.5	- 77
July	25.4	+0.9	263.5	-159
Aug.	27.9	-0.3	267.2	- 71
Sept.	21.7	-4.1	152.9	-102
Oct.	17.5	-1.3	56.1	- 50

† 10-year (1987-1996) mean.
‡ Departure from normal.

Table 3. Inital flowering and harvest dates of the summer annual legumes and grasses planted on two dates.

Crop[†]	Cultivar	Initial flowering date[‡]	Harvest date
		18 June planting	
Soybean	Baegunkong	3 Aug.	7 Sept. (81)[§]
	Namhaekong	4 Aug.	7 Sept. (81)
	Sobaeknamulkong	1 Aug.	7 Sept. (81)
Mungbean	Keumsungnogdu	3 Aug.	1 Sept. (75)
	Nampyungnogdu	3 Aug.	1 Sept. (75)
Maize	Pioneer 3525	22 Aug.	1 Oct. (105)
Sorghum (S)	Pioneer 931	24 Sept.	18 Sept. (92) (16 Oct.)[¶](120)
S×sudangrass	Pioneer 988	24 Sept.	18 Sept. (92) (16 Oct.) (120)
Japanese millet	Cheju native	1 Sept.	1 Sept. (75) (16 Oct.) (120)
		15 July planting	
Soybean	Baegunkong	20 Aug.	26 Sept. (73)
	Namhaekon	18 Aug.	26 Sept. (73)
	Sobaeknamulkong	11 Aug.	26 Sept. (73)
Mungbean	Keumsungnogdu	22 Aug.	18 Sept. (65)
	Nampyungnogdu	20 Aug.	18 Sept. (65)
Cowpea	Cheju native	23 Aug.	18 Sept. (65)
Adzuki bean	Chungjupat	21 Aug.	26 Sept. (73)
Maize	Pioneer 3525	11 Sept.	17 Oct. (94)
Sorghum (S)	Pioneer 931	16 Oct.	13 Oct. (90)
S×sudangrass	Pioneer 988	16 Oct.	13 Oct. (90)
Japanese millet	Cheju native	7 Sept.	9 Sept. (54)

† Data for cowpea and adzuki bean planted on 18 June were not obtained because of poor stand establishment.

‡ Silking date for maize and heading date for sorghum, sorghum × sudangrass and Japanese millet.

§ Numbers in parenthesis are days after planting.

¶ Data in parenthesis in the second rows are for the second harvest.

The initial flowering (heading dates for the grasses) and harvest dates are shown in Table 3. Legumes, maize, sorghum and sorghum × sudangrass hybrid, and Japanese millet were harvested at R6 (Fehr & Carviness, 1977), 36 to 40 days after silking, 30% heading, and mid-heading stages, respectively. Plant height was measured at harvest on ten representative plants. Canopy height was measured for cowpea because the plants were viny. Forage was hand harvested from three center rows 2 m long (3 m^2) at about 7-cm cutting height. Harvested material was weighed fresh. Subsample was collected for each plot and dried at 80℃ in a forced oven to a constant weight, and then weighed to determine dry matter yield. Dried samples were ground through 1 mm-sieve for the analysis of chemical compositions. Total nitrogen was measured by the Kjeldhal procedure and reported as CP (N × 6.25). Ether extract, nitrogen free extract (NFE), CF and crude ash (CA) were determined by AOAC methods. Percentage total digestible nutrient was calculated according to the equation given by Wardeh (1981).

$$TDN\ (\%) = -17.265 + 1.212CP\ (\%) + 2.464\ EE\ (\%) + 0.835NFE\ (\%) + (\%)\ 0.448\ CF\ (\%)$$

Ⅳ. RESULTS AND DISCUSSION

Plant height and DM, CP, and TDN yields

Plant height (canopy height for cowpea) and DM, CP, and TDN yields are shown in Table 4. Because sorghum and sorghum × sudangrass hybrid tested in this study were very similar in traits measured, these two grasses are referred to as sorghums in this section. As expected, the legumes evaluated were much shorter than the grasses. Plant heights of the legumes ranged from 42.2 to 66.9 cm and varied with species and cultivars. Plant height of the grasses ranged from 159.4 to 330.9 cm and sorghums were tallest followed by maize and Japanese millet.

Averaged across cultivars, soybean produced 5,761 kg/ha of DM which was 20% greater than that of mungbean at 18 June planting. However, the average DM yield of soybeans was 30 to 53% of the grasses tested which produced 10,807 to 19,067 kg/ha depending on species.

Table 4. Plant height, dry matter (DM), crude protein (CP) and total digestible nutrient (TDN) yields of the summer annual legumes and grasses planted on two dates.

Crop	Cultivar	Plant height (cm)	DM yield	CP yield (kg/ha)	TDN yield ....
		18 June planting			
Soybean	Baegunkong	66.9	6,012	1,027	3,736
	Namhaekong	62.6	5,824	1,091	3,742
	Sobaeknamulkong	53.9	5,446	1,026	3,434
Mungbean	Keumsungnogdu	53.9	4,739	663	2,787
	Nampyungnogdu	51.1	4,948	679	2,921
Maize	Pioneer 3525	176.8	11,169	881	6,825
Sorghum (S)	Pioneer 931	317.0	18,778	1,260	9,867
		(32.0)	(289)	(65)	
S×sudangrass	Pioneer 988	330.9	17,896	1,166	9,570
		(31.8)	(311)	(68)	
Japanese millet	Cheju native	173.6	10,246	984	5,243
		(37.3)	(561)	(100)	
LSD (0.05)		15.8	1,729	243	940
		(3.6)	(135)	(22)	
		15 July planting			
Soybean	Baegunkong	60.0	5,812	1,012	3,712
	Namhaekon	61.8	5,758	1,081	3,683
	Sobaeknamulkong	42.2	5,022	1,096	3,512
Mungbean	Keumsungnogdu	61.9	4,245	687	2,554
	Nampyungnogdu	55.7	3,898	675	2,382
Cowpea	Cheju native	61.3[†]	3,289	552	2,055
Adzuki bean	Chungjupat	45.0	3,931	674	2,489
Maize	Pioneer 3525	209.8	14,220	1,057	8,459
Sorghum (S)	Pioneer 931	321.3	15,074	1,196	7,847
S×sudangrass	Pioneer 988	321.5	14,502	1,091	7,515
Japanese millet	Cheju native	159.4	5,768	774	2,938
LSD (0.05)		9.3	1,391	139	792

† Canopy height.

At 15 July plantings, among the legumes evaluated, soybean (5,531 kg/ha) averaged across cultivars yielded the greatest DM followed by mungbean (4,072 kg/ha), adzuki bean (3,931 kg/ha) and cowpea (3,289 kg/ha). The average DM yield of soybeans was 37 to 98% of the grasses tested which produced 5,768 to 15,074 kg/ha of DM. Among the grasses, sorghums had the greatest DM yield while Japanese millet had the least. There was no significant cultivar difference in DM yield for soybean and mungbean regardless of planting dates. Lee et al. (1995), however, reported that DM yields of ten Korea recommended soybean cultivars ranged from 6,020 to 10,603 kg/ha at 90 days after planting at Chungju. Shin (1987) reported that a soybean genotype planted in mid-May produced 12,440 kg/ha of DM in South Korea. The DM yields of soybean were lower for this study than for other studies, indicating growing conditions for this study were not so favorable. Dry matter yields of soybeans in the USA were reported to be 6.8 to 15 Mg/ha at R7 stage (Hintz et al., 1992; Munoz et al., 1983).

At 18 June planting, soybeans (1,048 kg/ha) averaged across cultivars had 56 and 19% greater CP yields than mungbean and maize, and had similar CP yield to Japanese millet but had 18% less than sorghums. At 15 July planting, soybean (1,063 kg/ha) across cultivars produced 56, 93, 58, and 37% greater CP than did mungbean, cowpea, adzuki bean, and Japanese millet but was similar to maize and sorghums for CP yield.

At 18 June planting, soybeans (3,637 kg/ha) averaged across cultivars had 27% greater TDN yields than mungbean did and but had 31, 47, and 63% less than Japanese millet, maize, and sorghums. At 15 July planting, TDN yield was 47, 77, 46, and 24% higher in soybean than in mungbean, cowpea, adzuki bean and Japanese millet. The TDN yield of soybean was 47 and 43% of sorghums and maize. There was no significant cultivar difference in TDN yield for soybean, mungbean and sorghums regardless of planting dates.

Forage quality

Soybean was significantly higher in CP, EE, and TDN contents but was lower in NFE content compared with the other legumes (Fig. 1, 2, 3, 6.). The legumes had much higher CP, EE, and TDN contents but lower CF content than did the grasses except maize which had relatively lower CF content but higher TDN content(Fig. 1, 2, 4, 6.). Crude protein contents of legumes ranged from 13.7 to 21.9% while those of the grasses from 6.48 to 13.5%. Among the grasses, Japanese millet had the highest CP content regardless of planting date while sorghums had the least.

Ether extract contents of the legumes ranged from 2.42 to 6.23% while those of grasses from 1.64 to 2.83%. Sobaeknamulkong planted on 15 July had much higher EE than the two other cultivars probably because of early maturity of Sobaeknamulkong at 15 July planting in comparison with the two other cultivars (Fig. 2.).

Among the legumes, adzuki bean (53.7%) had relatively higher NFE content compared with cowpea (48.7%), mungbean (48.5 to 53.2%), and soybeans (44.0 to 47.8%). The higher NFE in adzuki bean resulted from relatively lower CF content(Fig. 3, 4.). Among the grasses, maize had the highest NFE content (61.5%), sorghums had the intermediate (46.3%), and Japanese millet had the lowest (40.0%) averaged across planting dates(Fig. 3.).

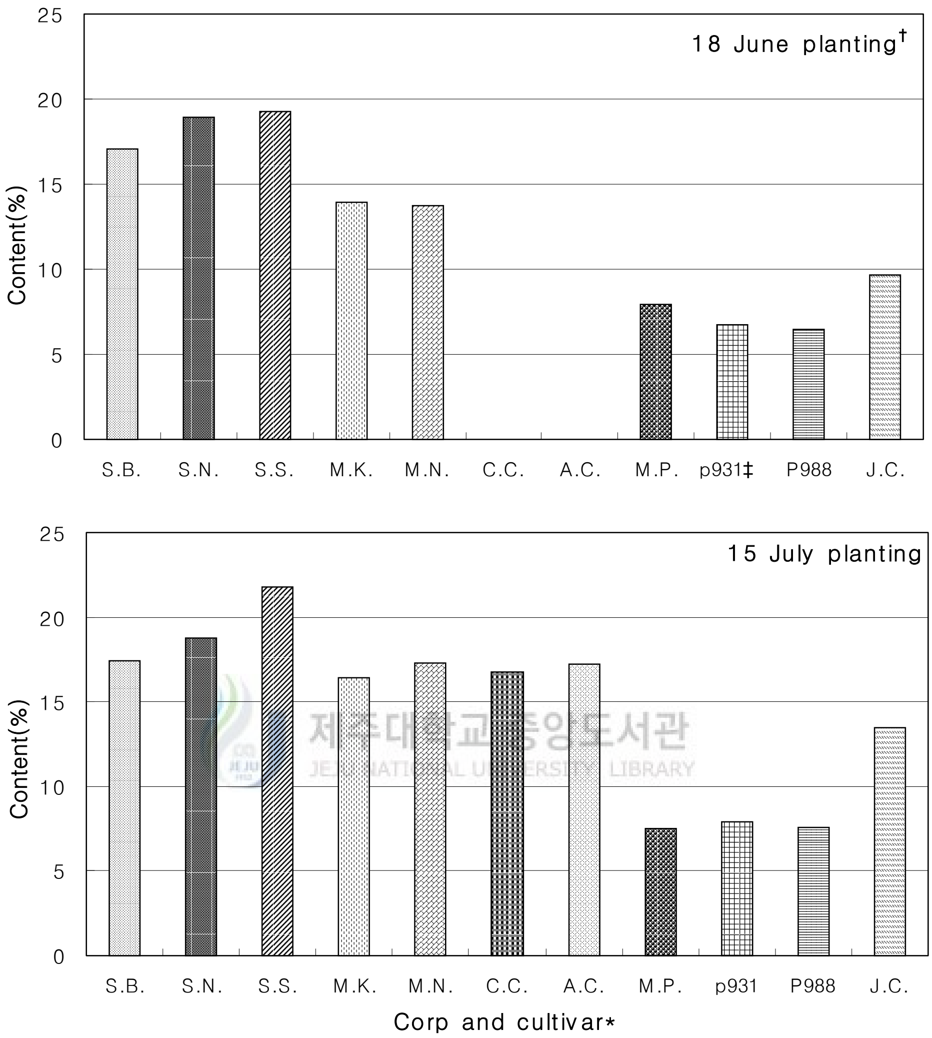

Fig. 1. Crude protein contents of the summer annual legumes and grasses planted on two dates.

*S.B.;Soybean(Baegunkong), S.N.;Soybean(Namhaekong), S.S.;Soybean(Sobaeknamulkong), M.K.;Mungbean(Keumsungnogdu), M.N.;Mungbean(Nampyungnogdu), C.C.;Cowpea(Cheju native), A.C;Adzukibean(Chungjupat), M.P.;Maize(Pioneer3525), p931;Sorghum(Pioneer 931), p988;Sorghum×sudangrass (Pioneer 988), J.C.;Japanese millet(Cheju native)

† Data for cowpea and adzuki bean on planted 18 June were not obtained because of poor stand establishment.

‡ CP contents at the second harvest for sorghum, sorghum×sudangrass and Japanese millet planted on 18 June were 22.5, 22.1 and 17.7%, respectively.

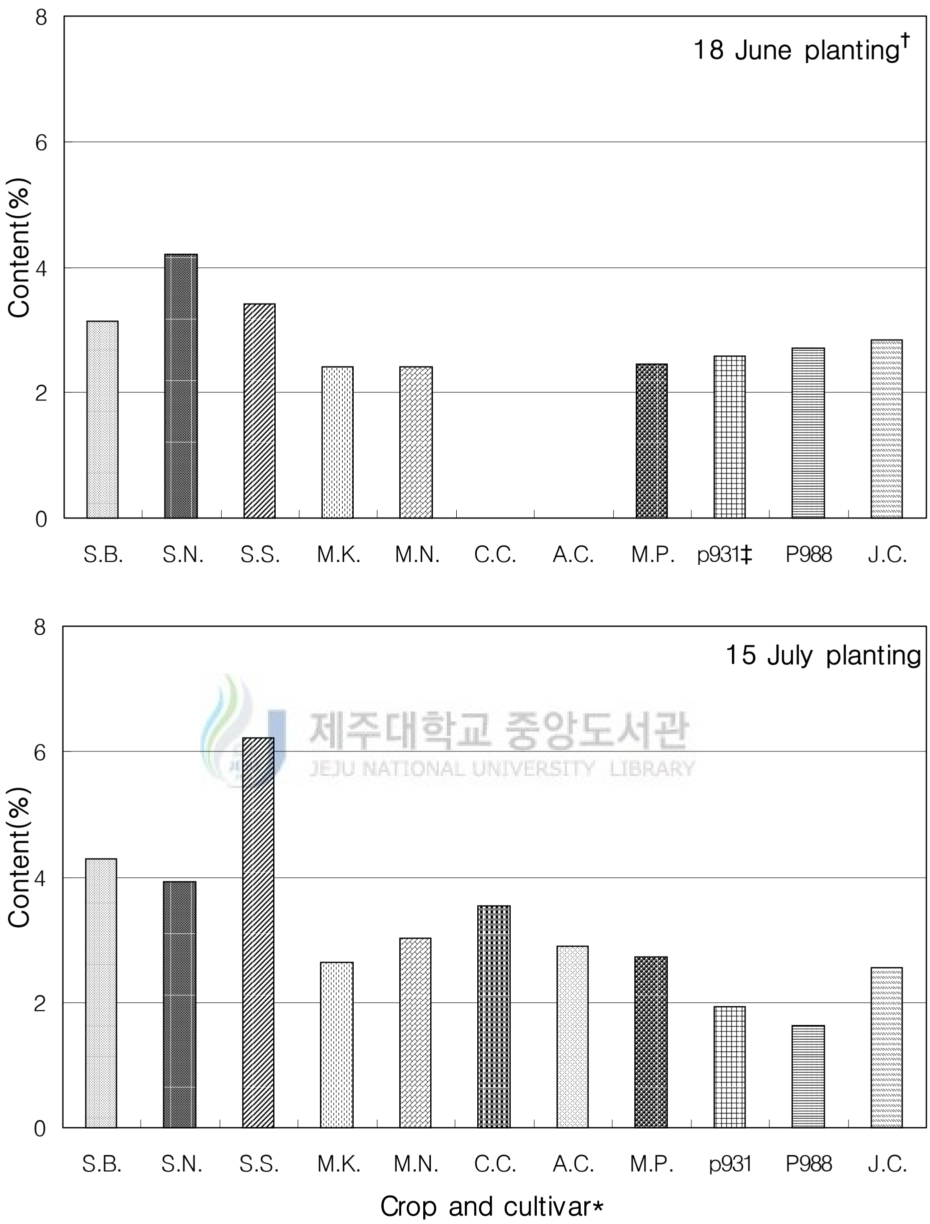

Fig. 2. Ether extract contents of the summer annual legumes and grasses planted on two dates.

*† ‡ See Fig. 1.

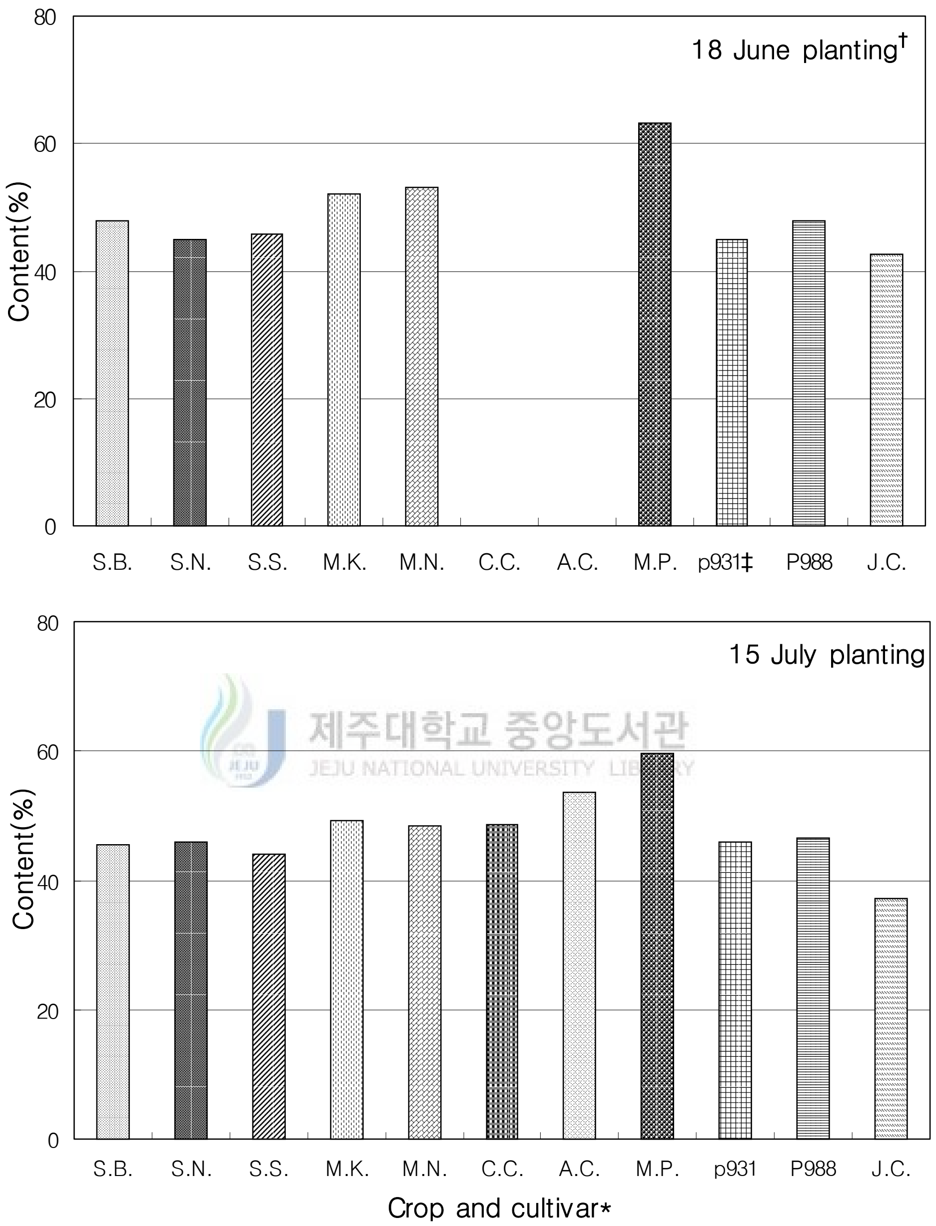

Fig. 3. Nitrogen free extract contents of the summer annual legumes and grasses planted on two dates.

*†‡ See Fig. 1.

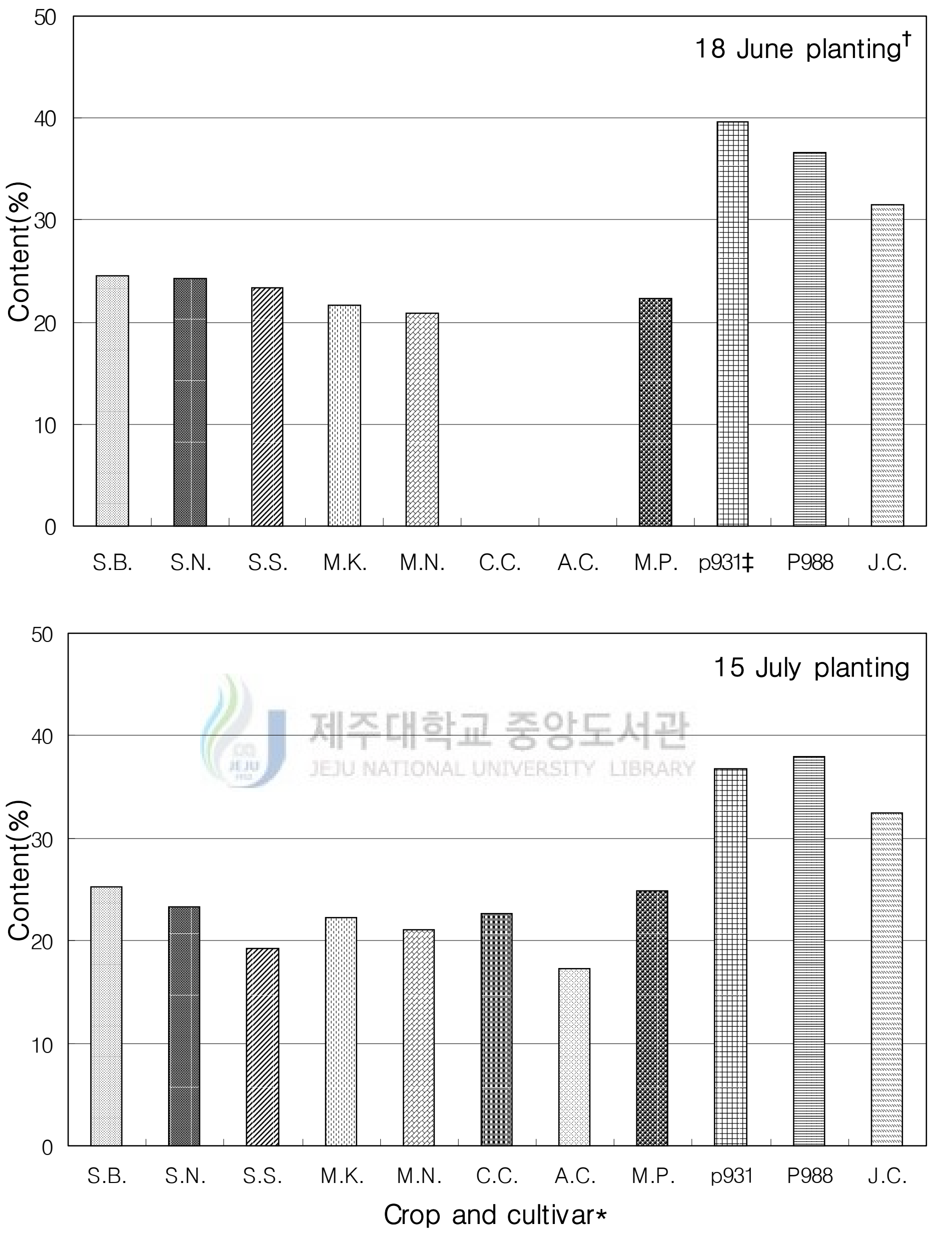

Fig. 4. Crude fiber contents of the summer annual legumes and grasses planted on two dates.

*† ‡ See Fig. 1.

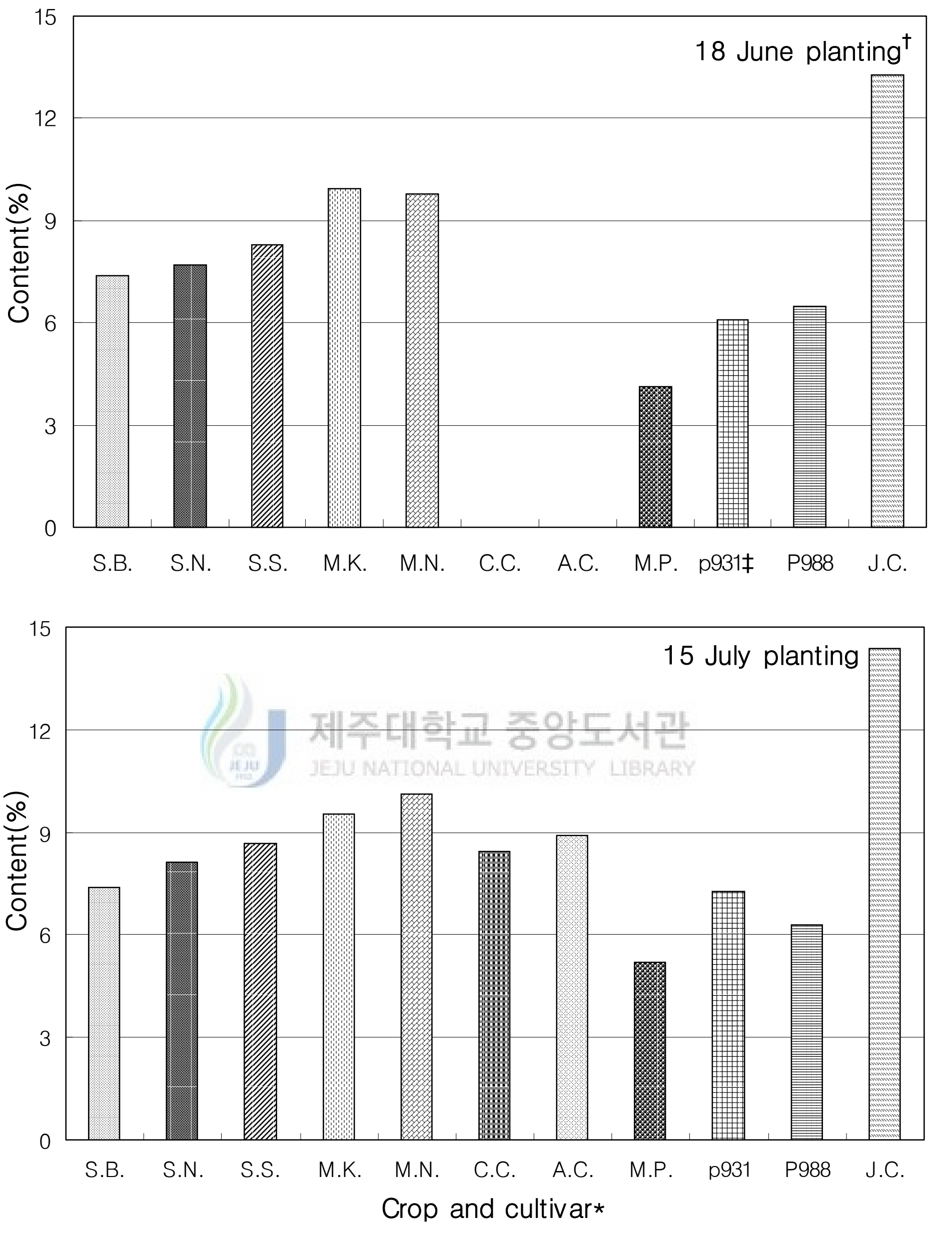

Fig. 5. Crude ash contents of the summer annual legumes and grasses planted on two dates.

*†‡ See Fig. 1.

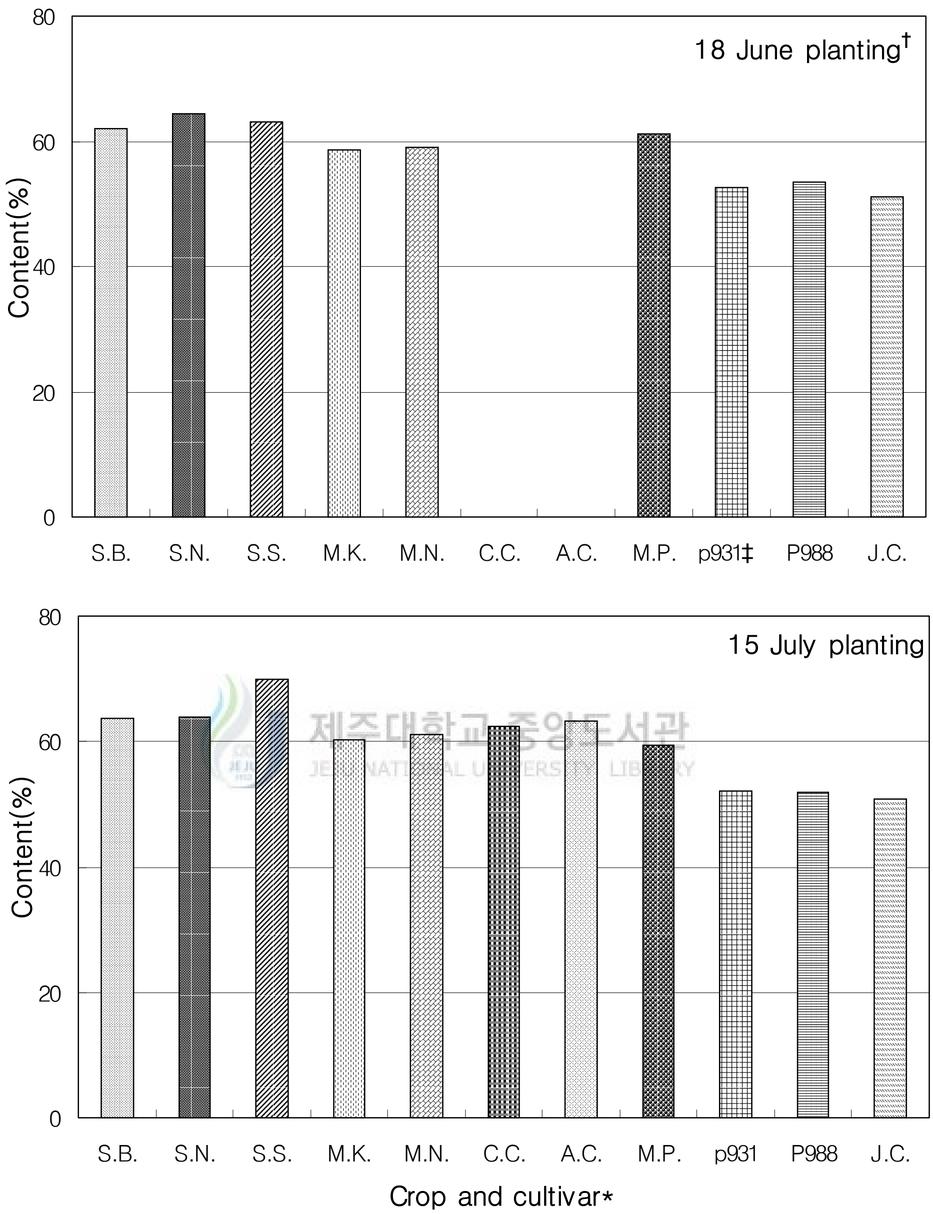

Fig. 6. Total digestible nutrient contents of the summer annual legumes and grasses planted on two dates.

*†‡ See Fig. 1.

The CF contents of the legumes ranged from 17.3 to 25.3% while those of the grasses from 22.3 to 39.6%. Soybean tended to have higher CF content compared with the other legumes(Fig. 4.). The growth stage at harvest may influence CF content of soybean forage because fiber increase from R1 to R5 and then decrease from R5 to R7 (Hintz et al., 1992). Among the grasses, maize averaged across planting dates had the lowest CF content (23.6%), Japanese millet had the intermediate (32.0%) and sorghums had the highest (37.6%).

The CA contents of the legumes ranged from 7.4 to 10.1% while those of the grasses from 4.1 to 14.4% (Fig. 5.). Among the legumes, mungbean had the greatest CA contents (9.5 to 10.1%) and the three other legumes had the similar CA contents (7.4 to 8.9%). Two mungbean cultivars were similar in CA content while among soybean cultivars, Sobaeknamulkong had higher CA content (8.5%) than did the two cultivars (7.6%). Averaged across planting dates, maize had the lowest CA content (4.7%), sorghums had intermediate (6.5%), and Japanese millet had greatest 13.8%). The higher CA content in Japanese millet might result from high Si content. Averaged across planting dates and cultivars, soybean (64.5%) had slightly higher TDN content than the other legumes (58.7 to 63.3%). Among the grasses, maize (60.3%) had higher TDN than did the three grasses (50.9 to 53.5%) (Fig. 6.).

Our data indicate that sorghums are the best adapted forage grasses in this region on the basis of TDN yield and among the popular summer grain legumes, soybean, in terms of CP and TDN yields, can be the best forage legume for grass-legume forage rotation in this region and good CP supplementary forage to sorghums with low CP content. Soybean requires only a quarter of N fertilizer compared with sorghums because of N_2 fixation and thus soybean cropping will reduce the NO_3-N contamination of ground waters. Some of fixed N by soybean become available for the next crop. Cropping soybean usually increase the yield of the next crop (Bagayoko et al., 1992).

Ⅴ. 適　要

禾本科-豆科飼料作物의 作付體系를 確立함에 있어서 濟州道에 適應하는 優秀한 豆類飼料作物을 選拔하기 위해 콩, 녹두, 동부, 팥, 옥수수, 수수, 수수×수단그라스교잡종, 피를 1997年 6月 18日과 7月 15日에 播種하여 乾物收量 및 飼料價値 등을 調査한 結果를 要約하면 다음과 같다.

播種期와 品種을 平均한 乾物收量, 粗蛋白質收量, 總可消和養分收量은 콩이 각각 5,646, 1,056, 3,637kg/ha, 녹두가 각각 4,458, 676, 2,489kg/ha, 동부가 각각 3,289, 553, 2,055kg/ha, 팥이 각각 3,931, 674, 2,489kg/ha, 옥수수가 각각 12,659, 969, 7,642kg/ha, 수수가 각각 17,071, 1,260, 8,857kg/ha, 수수×수단그라스교잡종이 각각 16,355, 1,163, 8,543kg/ha, 피가 각각 8,288, 929, 4,091kg/ha이였다.

콩이 다른 豆類에 비하여 粗蛋白質, 粗脂肪, 總可消和養分含量이 높았던 반면 可溶性無窒素物에서는 낮았다.

豆類는 비교적 粗纖維含量이 낮고, 總可消和養分含量이 높은 옥수수를 제외한 禾本科飼料作物보다 粗蛋白質(13.7~21.9%), 粗脂肪(2.42~6.23%), 總可消和養分(58.7~69.9%)含量은 높은 반면 粗纖維(17.3~25.3%)含量은 낮았다.

濟州地域에서 禾本科-豆科飼料作物의 作付體系를 確立함에 있어서 種實豆科作物 중 콩이 가장 有望할 것으로 判斷된다.

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